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U. S. DEPARTMENT OF AGRICULTURE.

REPORT

OF THE

ORNITHOLOGIST AND MAMMALOGIST

FOR

1892.

BY

C. HART MERRIAM.

FROM THE REPORT OF THE SECRETARY OF AGRICULTURE FOR 1892.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
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REPORT OF THE ORNITHOLOGIST AND MAMMALOGIST.

SIR: I have the honor to submit herewith my seventh annual report on the work of the Division of Ornithology and Mammalogy, covering the year 1892.

The long delayed bulletin on hawks and owls is now passing through the press and will be distributed before the present report is issued. This bulletin was practically ready for the printer four years ago, as announced in previous reports, but was withheld for lack of funds to pay for the colored plates. Its publication being imperatively demanded, and no provision having been made by Congress to meet the cost of the illustrations, the division has undertaken to issue them at its own expense. In order to do this several field agents have been discharged and various other expenses have been curtailed, by which means enough money has been reserved to pay for engraving on stone and printing in ten or twelve colors an edition of 5,000 copies of twenty-six plates of the hawks and owls of the United States. The number of applications for the bulletin now on file indicates that the edition will be entirely inadequate to meet the demand and is likely to be exhausted soon after its appearance.

A bulletin on the prairie ground-squirrels or spermophiles of the Mississippi Valley region is nearly ready for the press, and will be followed shortly by a similar treatise on the pocket-gophers. Both are illustrated by maps showing the geographic distribution of each species. Colored drawings of the animals have been made, but the cost of reproduction unfortunately precludes their publication as intended.

The bulletin on crows will go to press as soon as the report on the insect contents of the crow stomachs is received from the Entomologist.

In the year 1892 more than 3,000 letters were received, many of them accompanied by schedules, reports, and miscellaneous notes, all of which were examined and filed for future reference. During the same time about 2,000 letters have been written, several hundred schedules distributed to observers and correspondents, and upwards of 500 packages sent out. Other routine work has consisted in the identification of specimens (about 300 separate lots or packages of which have been received), forwarding supplies to field agents, care of collections, correcting proof, compiling reference lists of publications useful in the work of the division, and miscellaneous work.

The division has been crippled during the year by the continued demands upon the time of its chief in connection with the business of the Bering Sea Commission,* and also by the reduction of funds consequent upon the reproduction of the colored plates for the hawk and owl bulletin already mentioned.

* Dr. C. Hart Merriam and Prof. T. C. Mendenhall are the two Bering Sea Commissioners appointed by the President to serve without compensation pending the settlement of the questions submitted to the Tribunal of Arbitration to meet at Paris in February, 1893.

In closing, I have the honor to submit two recommendations, namely, (1) that provision be made for the employment of a competent artist so that the division will not be forced, as at present, to have its drawings made outside at the expense of the lump fund; and (2) that in the estimates for appropriations a sufficient increase be asked for to cover the cost of engraving and printing the plates necessary for the proper illustration of its reports and bulletins.

Respectfully,

C. HART MERRIAM,
Chief.

Hon. J. M. RUSK,
Secretary.

WORK OF THE YEAR.

OFFICE WORK.

Aside from the laboratory work, hereafter detailed under the head of "Economic Ornithology," the office force has been engaged in working up the results of investigations carried on in the field; in the preparation of reports thereon; in the identification of specimens received from field agents and correspondents, and in the care and arrangement of the collections.

PREPARATION OF REPORTS.

Report on the Death Valley Expedition.—This expedition was organized for the primary purpose of determining the actual boundaries of the natural life zones over the greater part of southern California and Nevada, and of studying the problems involved in the laws governing this distribution. The region was selected because of the exceptional advantages it offered for studying the distribution of animals and plants in relation to the effects of temperature and humidity at different altitudes from the bottom of Death Valley, which is below the level of the sea, to the summit of the High Sierra, culminating in the lofty, snow-capped peaks about Mount Whitney, at an elevation of nearly 15,000 feet. The close proximity of precipitous mountains and deep desert valleys often brings near together associations of species which in a more level country are characteristic of widely remote regions. In one place on the east side of the Sierra all the life zones of the North American continent from the plateau of Mexico to the Polar Sea may be crossed in traversing a distance of only 10 miles.

The area of which a biological survey was made comprises about 100,000 square miles in southern California and Nevada, situated between the parallels of 34° 30′ and 38° north latitude. It comprises also a small area in northwestern Arizona and southwestern Utah, thus including all of the torrid desert valleys and basin ranges between the High Sierra and the Colorado Plateau. The great Sierra Nevada was crossed along four distinct lines, and both slopes were worked with considerable detail. The Mohave Desert was traversed in various directions, and was worked to its extreme western end. Some work was done also in the Tejon Mountains—the westward continuation of the Sierra—in the Cañada de las Uvas, the San Joaquin Valley, and the coast region in Monterey and San Luis Obispo coun-

ties. Thus a broad zone, more than 200 miles in breadth and 500 in greatest length, stretching from the Pacific Ocean to the Colorado Plateau in Utah and Arizona, was covered by the operations of the division; and the present survey was practically connected with the biological survey of the San Francisco Mountain region in Arizona, made during the summer of 1889. (See North American Fauna, No. 3.)

One of the special objects of the expedition was the determination of the northern boundary of the Lower Sonoran life zone in the Great Basin—a matter of considerable importance, because this zone marks the northern limit of successful raisin production, and of the profitable cultivation of several subtropical fruits and other crops. The attempt to fix this boundary was undertaken with some misgiving by Mr. Bailey and myself, and was accomplished with great satisfaction after a horseback journey of about 1,700 miles. We succeeded in tracing the line in question completely across the deserts and barren ranges of the Great Basin all the way from the foot of the High Sierra in California to the foot of the Great Colorado Plateau in Utah; and, later in the season, other members of the expedition carried it northward along the west base of the Sierra.

The inexhaustible fertility of the soil in most parts of the arid region, and consequent high value of agricultural lands wherever water may be had in quantities sufficient for irrigation, taken in connection with the recent unparalleled development of the fruit-growing industry in southern California and Arizona, make it of the utmost importance to know beforehand just what crops are likely to prove most successful in each particular place, and point to the advantages that would result from mapping the boundaries of the areas fitted by nature for each of these products; for different parts of the Lower Sonoran zone are adapted not only to the successful cultivation of cotton and tobacco, but also to the needs of the orange, fig, and raisin grape.

In order to accomplish the objects of the expedition, it was necessary to make large collections representing the fauna and flora of numerous localities of different altitudes, to be studied in connection with the physical conditions and climatology of various parts of the several zones. The collections brought back and deposited in the U. S. National Museum comprise about 1,000 reptiles and batrachians, 1,000 birds, 6,000 mammals, 4,500 insects, and 25,000 plants, besides a number of fishes and mollusks from the hot springs of some of the interior deserts, and several hundred miscellaneous specimens. In working up these collections, the services of several naturalists of world-wide renown have been secured without expense to the Department, and their reports are now ready for publication.

The report of the expedition will be issued in two parts, the first comprising descriptions of the region traversed, discussion of the life zones and other general and theoretical matter, and the report on mammals; the second containing the special reports on birds (by Dr. A. K. Fisher), reptiles and batrachians (by Dr. Leonhard Stejneger), fishes (by President David S. Jordan and Prof. Charles H. Gilbert, of Leland Stanford, jr., University), mollusks (by Dr. R. E. C. Stearns), and the desert shrubs, yuccas, and cactuses (by Dr. C. Hart Merriam). Both parts are illustrated by plates and maps. The second part is now ready for the press; the first, for reasons already mentioned, is not finished but is being completed as rapidly as possible. A special report on botany has been prepared by Mr. F. V. Coville, botanist of the expedition, and will be published as a separate volume.

Reports on spermophiles and gophers.—From the agricultural stand-

point the pocket-gophers and spermophiles or ground-squirrels are of very great importance. Throughout their extensive range, wherever the land is under cultivation, they are among the most destructive of mammals, feeding on growing grain, fruit, and garden vegetables to such an extent that the annual losses from their depredations must be counted by hundreds of thousands of dollars. Many States and Territories have paid large sums in bounties for their destruction without in the main materially reducing their numbers. Several years ago the division began a systematic study of these animals in the field, with a view to the early publication of one or more bulletins on the subject. This work has been pushed during the past year, and a bulletin on the spermophiles of the Mississippi Valley region is now ready for the printer. A similar bulletin on the pocket-gophers is nearly ready, and will be followed by others.

Report on the crow.—(See "Economic Ornithology.")

FIELD WORK.

As already stated, field work has suffered in consequence of the curtailment of funds incident to the publication of the colored plates of the Hawk and Owl bulletin; hence no attempt was made to continue the systematic biological survey carried on in the years 1889, 1890, and 1891. At the same time considerable good work has been accomplished, particularly in the region west of the Mississippi River. The most important field work of the year consisted in tracing the northern boundary of the Lower Sonoran zone from New Mexico to the Mississippi River. This area is one of the best marked and most important agricultural regions in the United States, embracing the cane-sugar, cotton, and subtropical fruit districts of the Gulf States and the Southwest. The work of the Death Valley Expedition determined the extent of the Lower Sonoran region in southern California and Nevada and carried its northern boundary from the Pacific coast eastward to southwestern Utah, while the biological survey of the San Francisco Mountain region, made in the summer of 1889, supplemented by subsequent field work, extended it across the Territory of Arizona.

The task of continuing the survey of this boundary easterly from New Mexico was assigned to the chief field agent of the division, Mr. Vernon Bailey, who had assisted me on previous expeditions in running the line in question from California to Arizona. Mr. Bailey and assistants visited many points in Mississippi, Louisiana, Texas, Oklahoma, Indian Territory, Arkansas, southern Missouri, and western Tennessee and Kentucky, securing data by means of which this important boundary has been located with much greater precision than has been heretofore possible.

The great Lower Sonoran region which spreads over considerable portions of California, Nevada, Arizona, New Mexico, and Texas, and thence, modified by moisture, stretches easterly over the Gulf and South Atlantic States to the mouth of Chesapeake Bay, comes into the southern United States from the table-land of Mexico. In order to ascertain more completely its affinities and agricultural capabilities a thoroughly competent field agent, Mr. E. W. Nelson, was sent to Mexico to study the native fauna and flora in connection with the agricultural resources of the country, and has gathered much information and material of great value.

Other field work has been done in California, Arizona, New Mexico, Texas, Colorado, North and South Dakota, Nebraska, Kansas, Iowa,

Illinois, Kentucky, Tennessee, Mississippi, Alabama, Georgia, and the Carolinas, in the course of which the habits and geographic distribution of the various species of pocket-gophers and spermophiles or ground-squirrels have received special attention.

EXHIBIT AT THE WORLD'S COLUMBIAN EXPOSITION.

The division will be represented at the World's Fair by an exhibit illustrating both the work on the geographic distribution of species and that on the economic relations of birds and mammals. The main feature of the exhibit will be a model 20 feet in length and 10 feet in height, representing a mountain slope in the High Sierra of California, and showing the inhabitants of the different life zones from the subtropical deserts at the base to the arctic-alpine summit. On this slope the characteristic mammals, birds, and reptiles will be so assembled as to bring before the eye at a glance the successive faunas of the different elevations. In addition to this mountain slope, the results of the biological survey known as the Death Valley Expedition will be represented by a large model of the southwestern part of the United States south of latitude 38° and extending from southwestern Utah to the Pacific Ocean. This area is of peculiar interest, since the deepest depressions and the highest elevations in the United States are here found in close juxtaposition. The striking difference in altitude between the bottom of Death Valley and the summit of Mount Whitney (more than 15,000 feet), as well as the deep gorges of the Grand Cañon of the Colorado, the Yosemite Valley, and the Kings River Cañon are vividly brought out by the vertical scale, which is five times that of the horizontal. The fauna of the region will be represented by characteristic mammals, birds, and reptiles with appropriate surroundings. The exhibit will be accompanied by large photographs of typical desert scenery, and maps illustrating the geographic distribution of various species of mammals, birds, and plants.

The economic part of the exhibit comprises about thirty groups of mammals and birds, the subjects of which have been selected from species which are beneficial or harmful from an agricultural standpoint. Each group has been arranged to illustrate some feature in the life history of the species, and many are accompanied by an exhibition of their characteristic food.

NOTES ON SOME OF THE SPERMOPHILES AND POCKET-GOPHERS OF THE MISSISSIPPI VALLEY.

By Vernon Bailey.

The destructive animals that form the subject of the present notes belong to two widely different groups—namely, the pocket-gophers, which have external cheek pouches and resemble the moles in living underground and throwing up little mounds along the courses of their subterranean tunnels, and the spermophiles or ground squirrels, that run about over the plains and prairies. Two species of pocket-gophers and five species of spermophiles inhabit the Mississippi Valley proper; both of the former and three of the latter are here considered. Their individual characteristics are so well shown in the accompanying colored drawings by Mr. Ernest E. Thompson that specific description is unnecessary.

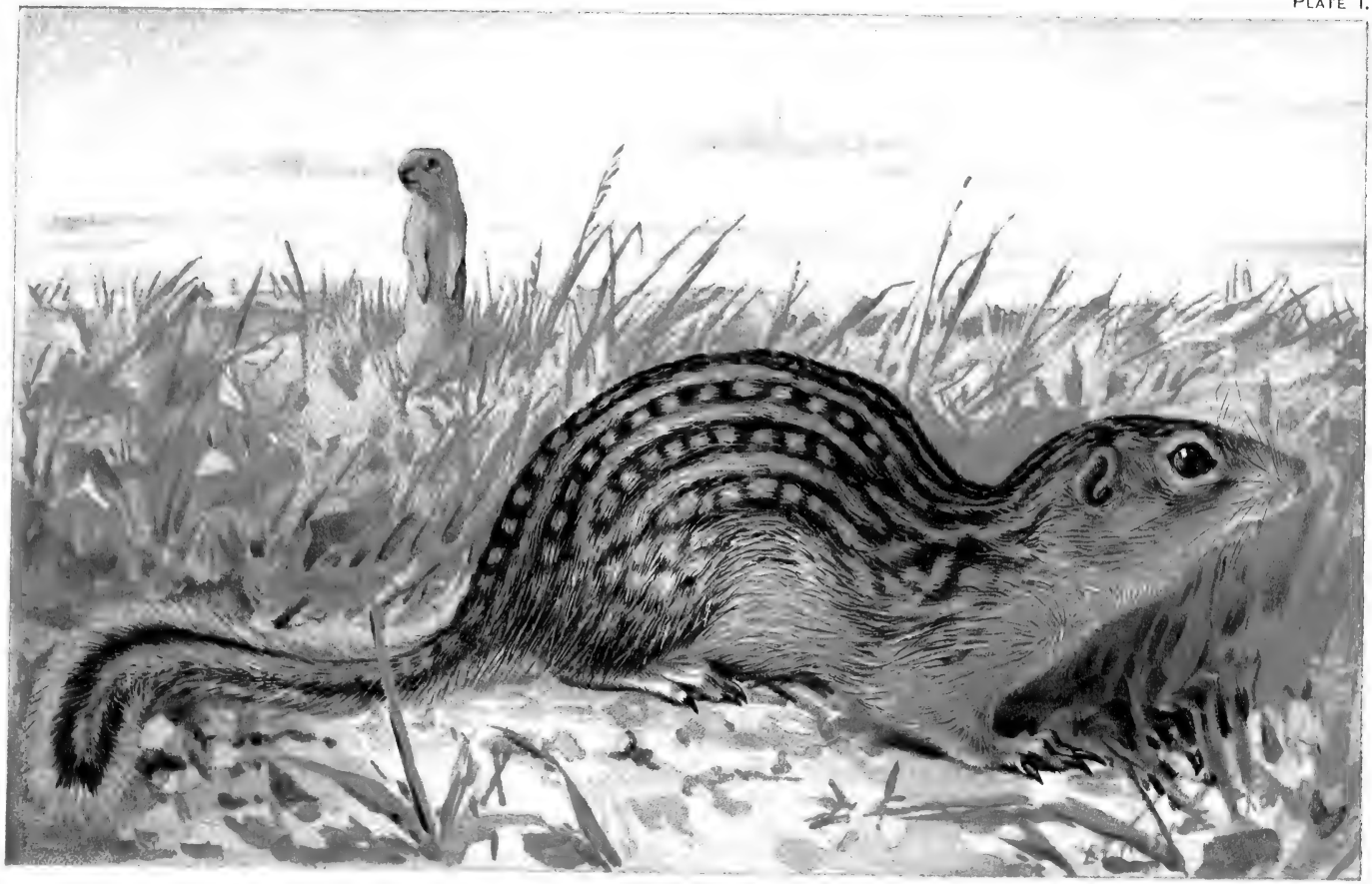
SPERMOPHILES.

The name *Spermophilus*, meaning seed lover (from σπέρμα, seed, and φίλος, loving, fond), is particularly appropriate for these animals, since scarcely a seed or grain grows where they live that is not eaten by them. The following list includes only such species as they have been seen actually eating, or as have been found in their cheek-pouches or stomachs: Wheat, oats, barley, rye, corn, acorns, hazlenuts, seeds of mountain rice (*Oryzopsis micrantha*), feather-grass (*Stipa spartea*), pigeon-grass (*Setaria*), millet (*Setaria italica*), panic-grass (*Panicum*), wild sunflowers (*Helianthus*), pig-weed (*Chenopodium*), bind-weed and knotweed (*Polygonum*), puccoon (*Lithospermum*), ragweed (*Ambrosia artemisæfolia*), buffalo peas (*Astragalus caryocarpus*), *Hosackia purshiana*, black locust (*Robinia pseudacacia*), three species of prickly pear (*Opuntia missouriensis*, *O. fragilis*, *O. rafinesqui*), basswood seeds, seeds and berries of wild solanum, and strawberries. But their food is by no means restricted to seeds, for they are fond of various fruits, roots, and insects, and are known to eat lizards, mice, or any kind of fresh meat that may be accessible.

They eat various kinds of berries, the fruit of the prickly pear (*Opuntia rafinesqui*), green foliage of numerous plants, roots of sorrel (*Oxalis violacea*), and wild larkspur (*Delphinium azureum*); and also such insects as adult grasshoppers, crickets, and beetles, the larvæ of beetles and coleopterous insects; ants, eggs of insects, and chrysalids. Feathers of small birds were found in a few stomachs, though not in sufficient quantities to prove that birds had been eaten; the feathers may have been swallowed by accident while being carried to be used for the lining of their nests.

If one of their own species is found dead it is promptly eaten, thus proving that they are cannibals as well as generally omnivorous. An examination of the stomach contents of a large number of striped, Franklin's, and Richardson's spermophiles brings to light the interesting fact that these animals not only feed extensively on insects but that about 50 per cent of the stomach contents consist of this food alone. Moreover, most of the insects eaten are injurious to crops, as grasshoppers, crickets, and certain beetles. It is evident, therefore, that the spermophiles do much good, and not alone by preying on insects, for they destroy also large quantities of seeds of noxious weeds. At the same time it is not apparent that they do enough good to offset the harm. In many localities it is impossible to harvest a full crop unless the spermophiles are killed. They attack corn, digging up the seed as soon as it is planted; but the greatest mischief is done within a week or ten days of the time of sprouting, or until all the nutriment is drawn from the grain by the growing stalk. As a single spermophile digs up many hills of corn in a day, and as the animals often average four or five to an acre, it is not difficult to see that where they are numerous serious damage results. Large fields of corn are sometimes destroyed and have to be replanted several times. Wheat, oats, barley, and rye are taken in the same way. Nor is the damage confined to the time of planting, for as the small grains begin to fill soon after blossoming the spermophiles cut down the stalks to reach the ovules, and in order to find the best heads cut a great deal more than they eat. And as the grain hardens they continue to cut it not only to eat on the spot but to carry off to their storehouses.

PLATE I.



Trautmann, Bailey & Blampey, N.Y.

FRANKLIN'S SPERMOPHILE. SPERMOPHILUS FRANKLINII. (Sabine.)

THE STRIPED PRAIRIE SPERMOPHILE (*Spermophilus tridecemlineatus*).

This well-known little animal is widely distributed throughout the central part of North America, ranging continuously from eastern Michigan to Wyoming and Colorado, and from central Texas north to the plains of the Saskatchewan in Canada, where it reaches latitude 55° N. In short, it occupies all of the prairie region east of the Rocky Mountains and is a true prairie-dweller, never entering a timbered region any more than the tree squirrels wander from their forest homes. But as the timber is cleared off and the country brought under cultivation it frequently follows the fields, and spreads to considerable distances from its original haunts. In Michigan forty years ago it was restricted to the few small prairies of the southern part of the State; to-day the southern half of the State is nearly as open as the original prairie country and the spermophiles have spread over it, reaching points as far north as Big Rapids in Mecosta County.

In Minnesota I have observed a similar extension of range, though on a smaller scale. When the timber was removed the spermophiles came in from adjoining prairies and were found about fields previously unoccupied by them.

The westward range of the species is limited by the Rocky Mountains, over which they do not pass, although they have penetrated well into the valleys on the east slope and climbed into some of the mountain parks.

FRANKLIN'S SPERMOPHILE (*Spermophilus franklini*).

Franklin's Spermophile is known locally under the names gray gopher, gray ground-squirrel, scrub-gopher, and several others, each distinctive enough in the limited region where it is used, but beyond the range of the species applying equally well to nearly half a dozen, more or less, similar animals which inhabit the Rocky Mountain and Pacific coast regions. Hence, the name Franklin's Spermophile, which can not be confounded with that of any other, is here adopted.

This spermophile inhabits the prairie region from the plains of the Saskatchewan south to southern Missouri, and in an east and west direction ranges from western Indiana to about the middle of Kansas and Nebraska. In other words, it occupies the moist and fertile eastern prairies, while its cousin the prairie-dog (*Cynomys ludovicianus*) is confined to the more arid plains that stretch westward from the prairies of the Mississippi to the Rocky Mountains. A widely isolated colony of these spermophiles exists in eastern New Jersey, in the region about Tuckerton, where a single pair, brought from Illinois, escaped from their cage in 1867. They are said to dig such shallow burrows that they are easily dug out by dogs, and in this way their numbers are held in check.

I am informed by Prof. C. B. Waldron, arboriculturist of the North Dakota Agricultural College and Experiment Station, that in eastern North Dakota, where Franklin's Sphermophile was formerly abundant, it is now being driven out by Richardson's Spermophile, which is on the increase in this region.

Prof. L. L. Dyche, of Lawrence, Kans., writes that on his father's farm at Auburn, Kans., these spermophiles were very common several years ago. He states further:

They would dig up the corn almost as fast as it was planted for a distance of a few rods in from the stone walls wherever the latter inclosed the fields. On an average,

I think there could not have been less than one squirrel for each rod of fence; apparently there was one for each few feet. We killed many of them with guns, and tried to poison them with apparently very little success. By scattering shelled corn along the fences for the squirrels to feed upon while the planted corn was coming up, most of the difficulty was obviated. A wary old female cat, which had taken up her quarters in a barn in one of the fields, caught many of the squirrels, and was accustomed to carry them to her kittens when the latter were large enough to feed upon such things. The offspring of this cat, when they were full grown, also preyed upon the squirrels. In the course of a few years these cats, over a dozen in number, almost exterminated the squirrels. They would sit on the stone walls and pounce upon the squirrels when the latter came out from their hiding places.

RICHARDSON'S SPERMOPHILE (*Spermophilus richardsoni*).

Richardson's Spermophile, which resembles a small prairie-dog in general build and coloration, is not found in the United States, except in North Dakota and Montana, where it is abundant, troublesome, and apparently on the increase. Prof. C. B. Waldron writes that it is harder to contend with than any other species, and that the damage done by it is greater and greater each year. He says:

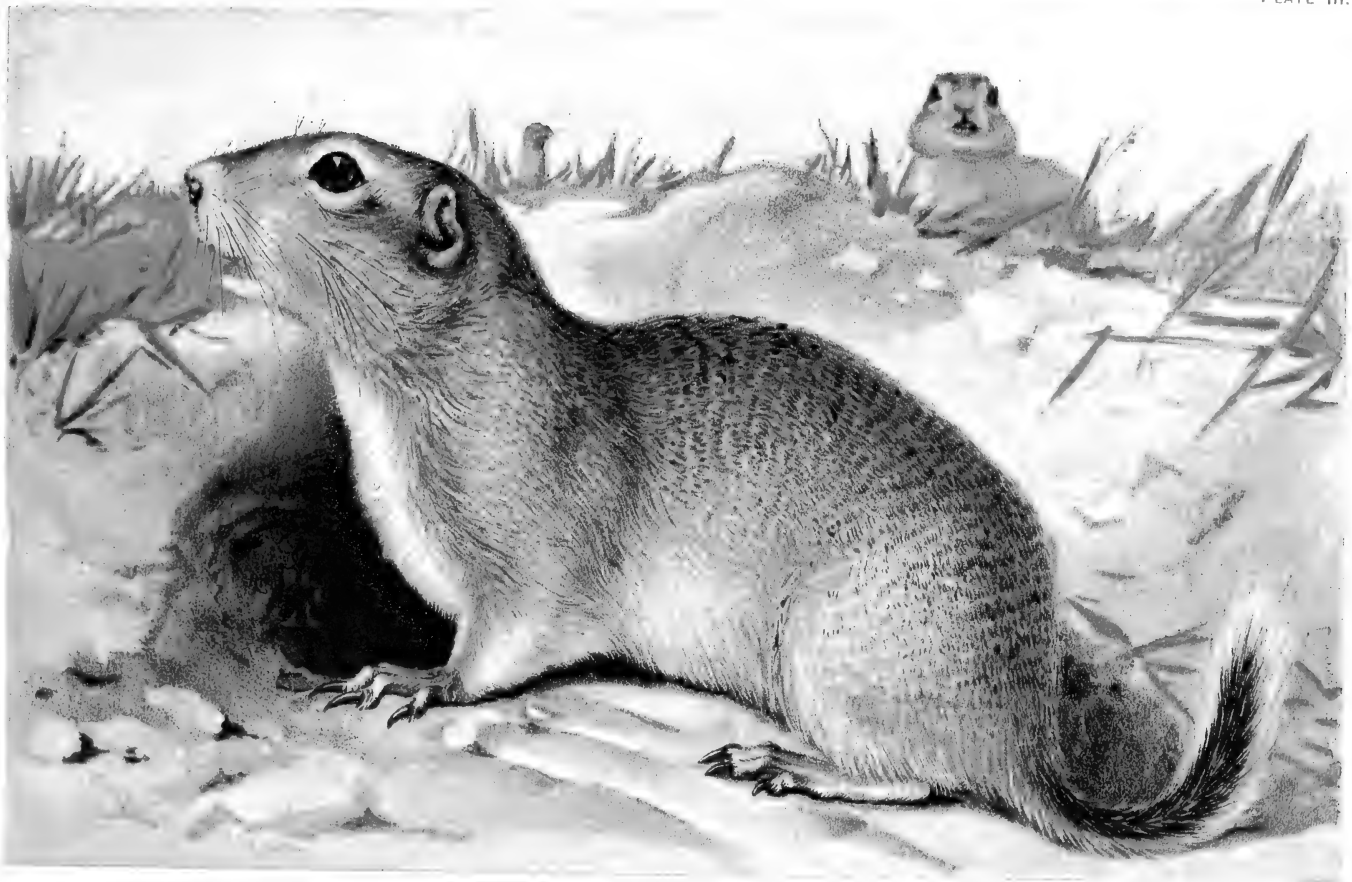
Its chief depredations are committed during the months of June and July, when growing grain, especially corn, peas, and garden crops, are apt to be entirely destroyed by it. It is found in greatest abundance in the agricultural regions lying just west of the Red River Valley, and seems to thrive best in the presence of civilization. For several years it has been encroaching upon the farms in the Red River Valley proper, but the wet season of last year [1891] very nearly or quite exterminated it on the level lands.

At Turtle Mountain, on the boundary between North Dakota and Canada, one of these spermophiles was shot by the writer as it ran from a shock of oats. Its cheek pouches contained 269 grains of oats.

POCKET-GOPHERS.

Pocket-gophers are stout, thickset animals, about the size of a rat, with small eyes and powerful forefeet armed with strong curved claws for digging. They are in every way fitted for underground life, and no other American rodent is so exclusively subterranean. They owe their name to the possession of large fur-lined cheek pouches, in which they carry the roots and other parts of plants collected for food. These pockets are used exclusively for this purpose, and not, as some suppose, for transporting earth in excavating the burrows. Roots and stems are cut in sections, about an inch in length, by means of the powerful front teeth, and are packed lengthwise in the pouches. Food not needed for immediate use is carried to chambers in the burrow and there stored for future use.

Pocket-gophers are best known from the little mounds of earth thrown up along the lines of their subterranean tunnels, and universally called "gopher hills." These mounds ordinarily contain 5 or 6 quarts of earth, and since the gophers work all summer and to some extent in winter also the total quantity of earth brought to the surface is considerable. From observations made in Minnesota I have estimated that about 500 square feet of ground is covered with subsoil by a gopher in the course of a season of seven months, supposing that he worked steadily all the time—which of course he does not. In case the soil is shallow and the subsoil poor the idea may be true that gophers do much injury by bringing clay or sand to the surface, but in general they undoubtedly do great good in plowing and draining land beneath the reach of the plow, while on the fire-swept prairies the only vegetation



Prentiss Bailey & Blompey N.Y.

RICHARDSON'S SPERMOPHILE, SPERMOPHILUS RICHARDSONII (Sabine.)

which remains to decay and fertilize the soil is that which the gopher hills cover and protect from the flames.

The pocket gophers are even greater enemies to agriculture than the spermophiles. This is partly due to the circumstance that most of their work is done under ground and consequently out of sight, and partly to the fact that practically the whole of their food is of such a nature that the taking of it is an injury to mankind. In addition to the cereals which they devour in common with the spermophiles, they feed eagerly upon potatoes, carrots, turnips, and the like, and also on the roots of vines and fruit trees. Perhaps the most serious losses due to their ravages are in orchards, vineyards, and gardens.

When allowed in the fields they injure almost every farm crop that can be raised, but are especially destructive in alfalfa patches, meadows, and fields of small grain, where every hill thrown up covers and kills the plants on the spot where it lies. The damage done by a single gopher in a season is often considerable, and where the animals are numerous the injury becomes serious. A slight loss is sometimes suffered from the grain cut down and eaten, or carried into their holes. Sometimes a few bundles are destroyed in the shock, but this damage is slight compared with the loss of the grain covered up while growing. I have never known them to destroy any appreciable quantity of corn. They are very fond of potatoes, and occasionally one will follow a row for some distance and not leave a potato in any of the hills; farmers have told me of losing all the potatoes in a small patch, and, at the same time, have acknowledged their inability to catch the culprit. Turnips, beets, parsnips, and most garden vegetables are eaten whenever found, and a single gopher will destroy a surprising quantity of such crops. Perhaps none of their depredations cause the farmer more annoyance or provoke his impatience to a greater degree than the hills which they throw up in his meadows. The loss of the grass covered and eaten is not often of serious consequence, but in mowing with a machine the knife keeps running through the gopher hills, dulling and nicking and sometimes breaking the teeth. At such times it becomes necessary to sharpen the blades several times when ordinarily one grinding would suffice.

Two very distinct kinds of pocket-gophers inhabit the Mississippi Valley, one having deeply-grooved upper incisors and very large forefeet and claws (genus *Geomys*); the other with the upper incisors plane and the forefeet and claws smaller (genus *Thomomys*). These differences are shown in the accompanying cut. There are several species in each genus, but only one of each occurs in the Mississippi Valley proper north of Texas and Louisiana.

GRAY POCKET-GOPHER (*Thomomys talpoides*).

The gray pocket-gopher has the most northerly range of any species of the family, inhabiting the plains of the Saskatchewan, Montana, and the Dakotas; near our northern boundary it pushes easterly a few miles into the northwest corner of Minnesota. In eastern North and South Dakota it overlaps the range of the red pocket gopher (*Geomys bursarius*), both occurring over a narrow strip east of James River. Other species of *Thomomys* inhabit all the States and Territories west of the Great Plains and range south into Mexico, but singularly enough none occur in Nebraska, Kansas, Indian Territory, Oklahoma, or eastern Texas, where *Geomys* alone holds the ground.

In the construction of burrows and nests and the mounds thrown up

there is little difference between this species and *Geomys bursarius*, except that being a smaller animal the burrows are correspondingly smaller and the mounds are smaller and closer together. Usually after some familiarity with both it is not difficult to distinguish by the mounds which species is living beneath.

Thomomys talpoides is as solitary in habits as the other members of the family. Except during the mating season in spring it is rare to find more than one in a burrow, and, as the burrows of different individuals do not commonly connect, the animals must live in absolute solitude throughout the greater part of the year.

RED POCKET-GOPHER (*Geomys bursarius*.)

This species may be distinguished from the preceding not only by its reddish color and larger size, but also, as already stated, by its deeply-grooved upper front teeth and larger forefeet and claws. It occupies by far the greater part of the Mississippi Valley to the exclusion of all other species of true gophers, ranging from a point a little north of Grand Forks in the Red River Valley, on the boundary between North Dakota and Minnesota, southward to Indian Territory and Texas, where, however, it shades off toward another species. In an east and west direction it ranges from western Indiana to the foot of the Rocky Mountains in Colorado. In the Dakotas its range is restricted to a narrow strip east of James River, where it slightly overlaps the range of the smaller species (*Thomomys talpoides*).

METHODS OF DESTROYING PRAIRIE-DOGS, SPERMOPHILES, AND POCKET-GOPHERS.

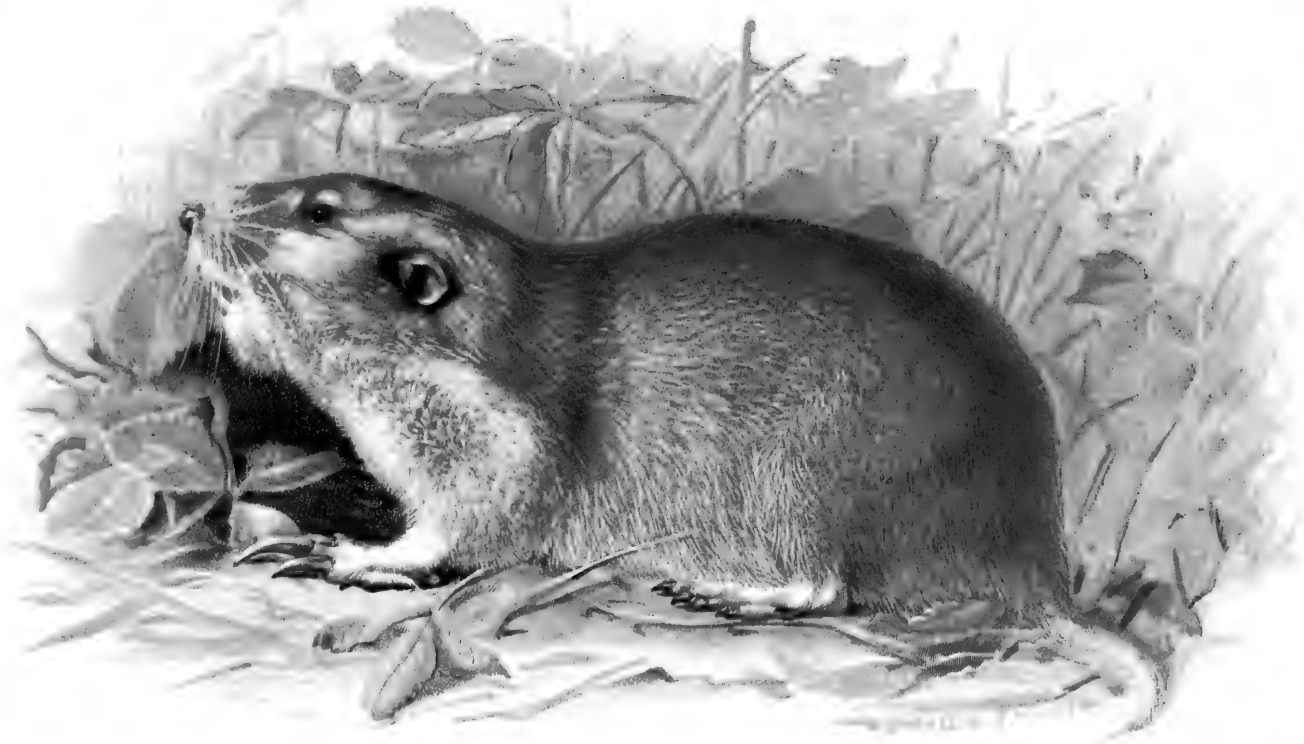
The injury to crops caused by prairie-dogs, ground-squirrels, and pocket-gophers is an evil of such magnitude over more than two-thirds of the total area of the United States that there is a general demand for some economic means of destroying them. So many letters are received from correspondents requesting information under this head that it seems desirable to refer briefly to the methods which practical experience has shown to be most effective.

Pocket-gophers, spermophiles, and prairie-dogs may be caught in traps or poisoned.

TRAPPING.

Trapping is slower than poisoning, but has the advantage of being simple and safe. Few animals are more readily taken in this way. In the case of prairie-dogs and spermophiles a "No. 0" steel trap (made with the spring under the pan) should be set at the mouth of the hole, lightly covered with fine earth, and baited with almost any kind of grain. Bait is not always necessary, and in the case of a few of the spermophiles it is unnecessary to cover the trap.

Pocket-gophers may be caught even more easily. It is best to select a fresh hole, and after removing the loose earth at the mouth of the burrow, set the trap in the main runway flush with the bottom. It may be noticed that the earth removed in excavating the burrow is brought to the surface at intervals by means of side passages, through which it is pushed up from below, forming the characteristic "gopher hills." After the load is deposited the mouth of the hole is closed, and



GRAY POCKET GOPHER, THOMOMYS TALPOIDES (Richardson.)

PLATE V.

Trautmann, Bailey & Blampey N.Y.

unless the animal happens to be working in the vicinity the side passage is likely to be abandoned and a new one made near the point from which the earth is being removed. The main passage, however, is usually kept open, as the occupant frequently passes back and forth. If the burrow is near the surface, the trap may be placed advantageously between two hills by digging down until the main burrow is reached, and setting the trap as before flush with the floor of the runway, so that the gopher will pass over it. A few bits of potato, turnip, or even grass may be scattered in the runway to attract the animal, but often no bait is necessary. Several special kinds of gopher traps are in use, but for ordinary purposes the No. 0 steel trap with the spring under the pan will be found as good as any.

POISONING.

Strychnine and bisulphide of carbon are the most speedy and effective poisons for the destruction of prairie-dogs, ground-squirrels, and pocket-gophers.

Strychnine.—In general, the scattering of strychnine about promiscuously is to be avoided on account of the danger to animals other than those for whom it was intended. In certain cases, however, it may be used to advantage, as is shown by the practical experience of Mr. Rollin C. Cooper, of Cooperstown, N. Dak. He writes, under date of November 28, 1888:

> I am farming 7,000 acres, and the gopher question has been one of great interest to me. I now think that I have the best of them and can rid my farm of them at little expense. I send men over my fields about twice in the spring, the first time as soon as the animals commence coming out of their holes, with wheat soaked in strychnine water. I use one ounce of floured strychnine to each bushel of wheat. Every farmer can flour his own strychnine with a case knife on any piece of iron or glass; it should then be put into quite warm water, dissolving the strychnine fully. Pour on to the wheat to be soaked until the wheat is nicely covered, letting it stand the necessary time. Soak the wheat twenty-four to thirty-six hours, or until somewhat soft. When sufficiently soaked, each man takes a teaspoon and a small can and walks over the fields, putting one teaspoonful into each hole. This being carefully done a couple of times each year will soon clean the animals out, and will greatly repay the farmer, even if repeated every year, as one man can go over 50 to 100 acres per day.

Bisulphide of carbon.—One of the simplest and probably on the whole the most effective and cheapest method yet devised for destroying these animals is by the use of bisulphide of carbon. This compound when pure forms a colorless, mobile liquid having a peculiar odor, and when taken internally is a violent poison. As usually obtained it contains impurities in the form of other compounds of sulphur which give it a strong and extremely offensive odor, and when inhaled soon causes death. For the purpose of destroying gophers or ground-squirrels the crude bisulphide is better and much cheaper than the pure article. Care should be taken in using it, as it is both inflammable and explosive. Its efficacy depends on the fact that its vapor is heavier than air and when introduced into burrows flows like water into all the recesses. This fact should be borne in mind in using it on sloping ground or in cases where there is reason to suppose that the holes contain water, as unless the poison is introduced at the highest opening of the burrow a certain part of the hole will remain free from it and here the animals may take refuge. If the holes contain water, this may act as a water trap preventing the diffusion of the vapor.

The method of using it for burrowing mammals is as follows: A small quantity (about 45 cubic centimeters or 3 tablespoonfuls for prairie-

dogs, and 30 cubic centimeters or 2 tablespoonfuls for spermophiles and pocket-gophers) should be poured upon a bunch of rags or waste, which should be immediately placed within the mouth of the burrow, and the burrow closed.

During the past summer experiments were made by the writer in poisoning several species of mammals. The animals were secured by a long cord, and were then allowed to retreat into their burrows, when a measured quantity of bisulphide of carbon was introduced and the time necessary for it to cause death noted. The results of the experiments are shown in the accompanying table:

Tabular statement showing results of experiments in poisoning small mammals with bisulphide of carbon.

Species.	Distance from mouth of burrow.	Diameter of burrow.	Amount of bisulphide.	Time.
	Inches.	*Inches.*	*Cubic cm.*	*Min.*
Prairie-dog (*Cynomys ludovicianus*)	154	4	49	8
Do	99	5¾	49	5
Do	120	.....	49	5
Do	51	.....	49	6
Do	14	.....	29	*
Striped gopher (*Spermophilus 13 lineatus*)	14	.....	.....	6
Common skunk (*Mephitis mephitica*)	14	.....	83	(†)
Pocket-gopher (*Geomys bursarius*)	60	.....	.....	‡5
Do	96	.....	36	6
Do	48	.....	29	9
Do	6	.....	29	*6

* Vapor passed by and did not completely fill burrow. At end of time the animal was anæsthetized, but revived.

† Anæsthetized in five minutes; revived three hours later.

‡ Not quite dead.

Prof. E. W. Hilgard, of the University of California, deserves the credit of originating the bisulphide method of destroying burrowing mammals. In a bulletin "On the destruction of Ground Squirrels by the use of Bisulphide of Carbon," published in 1878, he states:

It is hardly necessary to enlarge upon the importance to California agriculture of devising some ready, safe, and effectual means of putting an end to the constantly increasing inroads of the ground-squirrel upon the grain fields and pastures of the State. Unlike most of other wild animals, whose range diminishes as culture advances, the ground-squirrel finds an improvement of the conditions of its existence as the area of cultivation increases. Each year we hear of its taking possession of "fresh fields and pastures new," while rarely loosening its grip upon any district once invaded; and the tax it levies upon the grain-growers of some counties exceeds all the other taxes combined. The damage done during the past season in Contra Costa County alone was estimated by the board of supervisors of that county at not less than $150,000, while in many individual cases from 30 to 50 per cent of the crop was harvested by the squirrels before the reaper could take the field.

After describing the properties of bisulphide of carbon and some of its uses, he goes on to say:

It is curious that in no case have I known a squirrel to run out of the holes before the gas; when it meets it face to face in a run, death seems to be almost instantaneous. But in most cases the animals seem to retire to their nests to die there in a stupor. The mode of proceeding is simply this: Select one or two of the freshest holes in a burrow, introduce into it, as deep down as you can reach, a wide-mouthed ounce vial full of the liquid, upset the vial and withdraw it. * * * The holes may all be closed at once, with earth, which need not be rammed; the only object being to keep the gas in, and to see if any of the inmates dig out afterwards. * * * The dead animal is thus buried and out of sight in its own burrow, creates no stench, and poisons nothing; its flesh would not be injurious even if dug up. No other wild

or domestic animal runs any risk, unless it be the gopher. The holes retain an offensive odor for some time, and remain closed and untenanted. * * * As for the expense of this method, I have freed the most thickly-peopled portions of the University campus (level ground) from every vestige of squirrels with about a pound of the liquid per acre; about half an hour being spent by two men in closing the holes with shovels.

During the past five or six years this remedy has been recommended by the division, and has been used with success by numerous correspondents. Mr. Joseph Conaster, of Sunset, Wash., who was much troubled by the depredations of Townsend's spermophile, after using the poison, wrote, under date of July 20, 1892:

I think your bisulphide will exterminate the squirrels. Have annihilated two towns of them that I have been shooting and poisoning for three years. Did it all in two hours and am satisfied that the bisulphide will be the grand remedy of all.

ECONOMIC ORNITHOLOGY.

By Walter B. Barrows.

Studies have been made during the year of the food and economic status of many species of birds of prey, crows, jays, blackbirds, woodpeckers, cuckoos, kingbirds, robins, and horned larks. The work on crows has received constant attention, one or more assistants being occupied most of the time in examining stomachs of this species and in tabulating the results. The stomachs of more than 250 nestling crows were collected during May and June, and these, together with a larger number of stomachs of adults—more than 600 in all—have been examined, and, with the exception of the insect material, the results are ready for publication. As soon as the Entomologist's report is received the bulletin will go to press. About 700 blackbird stomachs have been examined, and most of the material for a report on the crow blackbird is now in hand and is being prepared for publication. Small numbers of the stomachs of woodpeckers, horned larks, and a few other species have been examined for the settlement of special questions referred to the section.

More than 2,400 bird stomachs have been received during the year, and about 2,000 have been examined during the same time. The collection now numbers 16,202 stomachs. The reference collection of seeds and other things likely to be found in bird stomachs has been very largely increased, and many slides have been prepared for the microscope.

Preliminary investigations of the food of cuckoos, kingbirds, cedar birds, robins, and some other species have been undertaken in connection with the exhibit for the World's Columbian Exposition, and in the case of the horned larks and cedar birds several facts of general interest have been brought out, which are embodied in the two following papers.

FOOD OF THE HORNED LARKS OR SHORE LARKS (*Otocoris*).

The horned larks or shore larks are well known in most sections of the United States either as residents or as winter visitors. During the larger part of the year they are found in flocks of varying size, sometimes of only half a dozen individuals, and again of hundreds; during the nesting season, however, they keep mostly in pairs. They frequent open fields, gravelly plains, or sandy wastes, and even in midwinter

few places are too bleak for them. They are strictly terrestrial, rarely alighting except on the ground, although at the approach of the nesting season the male occasionally perches on a rail or stone while singing. Much of the time, however, the song is uttered while high in the air, somewhat after the manner of the European skylark.

Owing to their gregarious habits, their fondness for open grounds, and their seed-eating propensities, it has been supposed that they were capable of doing considerable damage to grain crops; and at various times during the past two or three years complaints have reached the Department that they did great damage by pulling up newly-sprouted grain, particularly wheat and oats. The charge was not a surprising one, since the common crow and several American blackbirds are strongly addicted to this habit, and our horned lark is rather closely related to the European skylark, which is almost as notorious for his grain-pulling as for his song. Efforts were made to secure specimens of the bird while actually feeding in newly-sown grain fields, but, as usual in such cases, the specimens so much desired were the most difficult to obtain, and as yet the charge has been neither disproved nor sustained.

Many horned larks were collected, however, under such circumstances that their stomach contents should give a fair idea of the usual food of the species, and enough examinations have been made to warrant publication of the results.

Forty-seven birds taken in Wayne County, Mich., about June 1 (May 31, June 1 and 2) were shot in or near fields where corn was already up, and where Hungarian grass had been recently planted. Thirty-five of these were young birds, not nestlings, however, but young of the year, able to fly, and probably not fed at all by the old birds. As the food of these immature birds proves to be markedly different in some respects from the food either of nestlings or adults, it may be briefly considered here. Thirty-four of the young birds had eaten seeds of Hungarian in amounts varying from three or four kernels to at least one hundred, and several of the stomachs contained no other food. In two stomachs were found seeds of pigeon grass or foxtail grass, wild species belonging to the same genus (*Setaria*) as the Hungarian, and a favorite food of many species of birds. Other species of grass seed had been eaten by five of the birds. Seeds of various species of *Polygonum* (bindweed, knotweed, and smartweed) were found in fifteen of the stomachs; in addition, two birds had eaten seeds of the ragweed or bitterweed (*Ambrosia artemisiæfolia*), one had taken seeds of goosefoot or pigweed (*Chenopodium*), and two had eaten seeds as yet not identified. Two birds had eaten small amounts of oats, but the condition of the fragments renders it almost certain that these were "road pickings," obtained in the manner of the English sparrow from the droppings of horses. Of the entire contents of these stomachs 76 per cent was vegetal (mainly seeds), 6 per cent was animal (insects and spiders), and 18 per cent was coarse sand. Throwing out the sand the food consisted of 92.7 per cent vegetal matter and 7.3 per cent of insects.

The large amount of sand is worthy of notice, and its presence, together with the thickened muscular walls of the stomach, would be sufficient evidence to many naturalists of the granivorous habits of the bird. What is here spoken of as a stomach might be called a gizzard with more propriety, since in its shape and relative size it is strictly comparable with the same organ in doves, partridges, and domesticated fowls.

The fact that no green vegetable matter of any kind was found in these stomachs, and not a single sprouted seed, is rather remarkable, but it must be remembered that these were young and inexperienced birds, doubtless with good appetities and not much judgment, and having found an abundance of food of one kind (Hungarian grass seed) they were content for the most part with this. The small proportion of insects taken can be accounted for in a similar way. The birds were unskilled in catching insects, and naturally took only such as chance threw in their way. Most of the insects which would be likely to occur in abundance in almost bare and cultivated fields during the heat of a June day are quick-moving insects and not to be caught without some exercise of skill. Eleven of the stomachs contained no traces of insects; twelve others only such minute fragments as sufficed to determine them as bits of insect shell. Among the remaining birds one had eaten two small caterpillars and another a tiny grub, probably the larva of a small beetle. One contained two or three minute claws from the feet of a bug (Hemipteron), another a part of an ant, and still another the larger part of a tiger beetle (*Cicindela*). The bulk of the insect food seemed to consist of beetles, but in most cases the fragments were so small as to make their specific determination extremely difficult if not impossible.

Turning now to the twelve adult horned larks taken in the same fields and at the same time, a decided change in the proportion of animal and vegetable food is noticed. These twelve stomachs contained nearly 16 per cent of insects, 61 per cent of vegetable matter, and 23 per cent of sand; or, throwing out the sand, 20 per cent of the food consisted of insects and spiders, and 80 per cent of vegetable matter. The vegetable matter is essentially the same in kind as was found in the immature birds, but Hungarian grass seed occurred in only seven stomachs (and in those in reduced quantity); "road pickings" were rather more numerous, and one stomach contained several bits of corn, while two contained a few kernels of wheat. Possibly the grain in these last cases was seed corn and seed wheat, but as it showed no signs of sprouting it is equally possible that it was waste grain or derived from road pickings. The same species of grass and weed seed appear, with the addition of cabbage or turnip seed in a single stomach.

Except in amount, the insect food is not very different from that already recorded. Four stomachs were devoid of any traces of insects, and in four more the fragments were so small as to be unidentifiable, or only recognizable as parts of the shell of beetles. Among the better-preserved material was found a large spider, a small ant, several small beetles, two or three lepidopterous larvæ (2 caterpillars), and several small pupa cases. The fact that these adult birds had eaten, on the average, nearly three times as many insects as the immature birds, seems to argue a greater fondness for insects, but, as is shown later, it is altogether probable that nestlings are fed very largely on insects, and it is very likely that some of these birds when shot were engaged in collecting food for second broods of young still in the nest. At all events, the fact that at one time they were compelled to hunt insects diligently for their young must have modified their habits and increased their knowledge and skill in this direction. The fact that the amount of gravel (23 per cent) was nearly one-third greater than in the younger birds may seem a little odd, but it is hardly probable that the actual amount of gravel varies very much from hour to hour, or day to day, and its relative bulk therefore depends much upon the amount of food, whether the stomach be well filled or almost empty. Crows swallow

large quantities of sand or gravel whenever their stomachs contain food which needs grinding, and they have the power (and the disposition) to disgorge most of this gravel so soon as the grinding is done. We do not know that horned larks have such a power or habit, but from what we know of domesticated fowls it seems more probable that they retain most of the gravel swallowed until its sharp edges are gradually worn away by attrition, when it is discharged through the intestines.

As a general rule the young of granivorous as well as of omnivorous birds require a considerable amount of animal food, but the young of some birds, for example, pigeons, are fed by regurgitation, largely on vegetable food, and it is believed that many seed-eaters feed their young in the same way, the seeds and grain being first softened in the crop or stomach of the parent bird, and subsequently choked up for the benefit of the young. Whether or not horned larks regurgitate any food is not known, but as they nest very early in the spring—often before the last snowstorm of the season—the ability to do so would be a decided advantage to the birds, and occasionally might save the lives of the nestlings during unseasonable weather, when insect food was unobtainable.

The food of very young horned larks is therefore of special interest, and it is much to be regretted that a sufficient number of stomachs is not at present available for study. Our collection contains many stomachs of so-called young birds, but only two which are positively known to be nestlings. These two were taken in Niagara County, N. Y., April 30 and May 2, 1888, and from the appearance of the stomachs the birds were then nearly ready to leave the nest. An examination of the stomachs of these nestlings shows an average of 43 per cent of insects, 43 per cent of seeds and grain, and 14 per cent of sand. Ignoring the sand, the food consists of 50 per cent animal matter and 50 per cent vegetable. The insect matter is so finely ground by the action of the gizzard that it is impossible to say what and how many insects are represented, but evidently a large part of the material belonged originally to beetles. The vegetable matter in one stomach consisted entirely of the remains of seeds of foxtail grass (*Setaria glauca*); in the other, of two seeds of this species and several kernels of wheat, all but one in fragments. This wheat showed no signs either of germination or of previous maceration or digestion, hence the conclusion seems inevitable that it was waste grain, or newly-sown grain not yet sprouted. As one stomach contained 8 per cent of sand and the other 20 per cent it seems clear that the young birds were in good condition to digest hard grain, and it is not likely that they were furnished with any soft vegetable food.

In order to compare the summer and winter food of horned larks, ten stomachs collected in Canada, Illinois, Kansas, and the District of Columbia, during February and March, have been examined and the results are given herewith. Of the entire contents 6.7 per cent consisted of insects, 79.3 per cent of vegetable matter, and 14 per cent of sand; or, throwing out the sand, insects formed 7.8 per cent of the food, and vegetable matter the remaining 92.2 per cent.

As might be expected the insects represented are few both in species and individuals. Beetles occur in four stomachs and their larvæ in three; two stomachs contain remains of large bugs, and a single grasshopper had been eaten by one bird. Most of these insects undoubtedly were in a torpid or semitorpid condition, and it is surprising that so many should have been discovered, especially when it is remembered

that the birds keep entirely in the open ground, avoiding brush and woods of every description, and never searching for food along fences and stone walls, or in corners, where many winter birds are so likely to be found.

The vegetable food, on the other hand, is represented very fully, not less than a dozen species of seeds occurring in the stomachs, and sometimes in large numbers. Almost every stomach had some grass seed, and one or more species of *Sporobolus* occurred in eight of the ten stomachs. Seeds of pigeon-grass (*Setaria*) were common also, one stomach containing at least a hundred in addition to forty seeds of pigweed (*Chenopodium*). Other weed seeds which had been eaten freely were Roman wormwood (*Ambrosia artemisiæfolia*), sorrel (*Rumex acetosella*), amaranth (*Amarantus*), and buttonweed (*Diodia teres*). One stomach contained twenty of the large, hard seeds of the last-named species, a most troublesome weed, and one of the last seeds which any bird would be expected to eat.

SUMMARY.

The examination of these fifty-nine stomachs of the horned lark shows the following facts:

(1) The species is essentially granivorous, but, as in many other seed-eating species, insects are eaten more or less at all times, and, other things being equal, a larger proportion of insect food is taken when it is most abundant. Nestlings, however, appear to be fed very largely on insect food, even at a time when it must be collected with some difficulty. Before leaving the nest, however, young horned larks are able to digest grain and hard seeds, and are supplied with gravel for this purpose. After leaving the nest, young birds, at least for a time, do not eat as much insect food as the adults.

(2) The birds do not appear to discriminate, at any season, between injurious and beneficial insects, taking whatever is most abundant or most easily obtained. Probably the consumption of torpid insects in winter—even if the species were injurious—is of little account, since few of them would be likely to survive the winter. Considering the small average amount of insect food, 9⅛ per cent for the whole year, it seems probable that this element of the food is of slight economic importance.

(3) The evidence at hand does not warrant the belief that horned larks do any appreciable damage to grain crops. They may pick up some newly-sown grain or grass seed which has been left uncovered, but the loss thus caused must be trifling.

(4) On the other hand, the consumption of weed seeds at all seasons of the year is a positive benefit, although the amount of good done must vary much with circumstances. Any bird, however, which eats freely the seeds of such pests as pigweed, bitterweed, amaranth, and sorrel should be given the most perfect protection, unless it is clearly shown to have bad habits which offset the benefit thus conferred.

FOOD HABITS OF THE CEDAR BIRD (*Ampelis cedrorum*).

By F. E. L. Beal.

In connection with the investigation of the food habits of birds, now being carried on by the division, a series of one hundred and twenty-five stomachs of the common cedar waxwing (*Ampelis cedrorum*) was examined recently, and the results have been tabulated and embodied

in the present paper. While the number of stomachs is much less than could be desired, yet as but little based upon actual dissection has been published concerning the food habits of this bird, it may be interesting to give such facts as have been obtained, as they confirm many of the observations made by ornithologists, while they run somewhat counter to many of the popular ideas in regard to the species.

The cedar bird, or, as it is more commonly known among horticulturists, the "cherry bird," is popularly supposed to feed almost entirely upon small fruit, and it is a matter of common observation that during the season of cherries it visits the trees in great numbers, frequently completely stripping those which bear the earliest ripened fruit. Nevertheless, close observers have noticed that other elements enter into its diet, even at the time when fruit is most abundant, and have more than suspected that this bird does not quite deserve all the obloquy that fruit-raisers have heaped upon it.

The one hundred and twenty-five stomachs under consideration were obtained from twelve States, Canada, and the District of Columbia, as follows:

Pennsylvania	39	New Jersey	3
New York	34	Ohio	3
Connecticut	21	North Carolina	2
Massachusetts	6	Dakota	1
Iowa	5	Georgia	1
Virginia	4	Wisconsin	1
District of Columbia	4	Canada	1

No special relation was noticed between the food of the birds and their geographical distribution, all appearing to feed upon practically the same substances wherever obtained. The distribution in time, however, gives more interesting results.

Of the whole number of stomachs examined, 45, or 36 per cent, contained an appreciable amount of animal, *i. e.*, insect, remains. Besides these, 6 others contained traces of insects. In the stomachs in which insect remains were found, the amount varied from 1 to 100 per cent, but averaged 47 per cent. But if the 125 stomachs are taken into consideration, the insect remains amount to only 17 per cent of the whole quantity of food eaten.

Looking now at the distribution in time, we find that the 125 birds were killed during the year as follows: January, 3; February, 6; March, 5; April, 5; May, 18; June, 10; July, 19; August, 11; September, 26; October, 16; November, 4; and December, 2.

No remains of insects were found in the stomachs taken in the months of January, February, March, October, and December. Among the others they occurred to the following extent:

Month.	Number examined.	Number with insects.	Percentage containing insects.
April	5	1	20
May	18	17	94
June	10	4	40
July	19	8	42
August	11	2	18
September	26	12	46
November	4	1	25

Owing to the small number of birds taken in the months of April and November, not much reliance can be placed on the results obtained, but the data given by the food eaten in the other months may be safely

taken as representing a close approximation to the truth. Of the eighteen birds taken in May, all but one had eaten insects in quantities varying from 1 to 100 per cent. If the animal food is compared with the whole amount taken in the month, it is found to be 51 per cent. If, however, the mineral constituent of the stomach contents is omitted as not being strictly food, the ratio of animal matter rises to 55 per cent. In the month of June ten birds were taken, four of which had eaten insects to an extent averaging 54 per cent of their food. If, as before, the animal food is compared with the whole amount taken by all the birds, the ratio is 22 per cent. In the same way it is found that the insects eaten by the eight birds in July formed 50 per cent of the food. Considering the whole quantity of food eaten by all the birds taken in this month, the animal matter amounts to 21 per cent. Of the eleven birds taken in August, only two had eaten insects, but these two had taken them to an average extent of 70 per cent; when compared with the whole amount taken by all, the ratio falls to 13 per cent.

In September twenty-six birds were examined, twelve of which had eaten insects in widely varying quantities, but giving an average of 32 per cent of all their food. Comparing as before the animal food with the whole amount of food taken in this month, the result is 15 per cent.

Among the birds examined were three nestlings which merit a passing notice. Their stomachs contained respectively 80, 84, and 100 per cent of insect food, or an average of 88 per cent. These insects consisted of Scarabæid beetles (*Aphodius fimetarius*) and the three birds had eaten thirty-two of them. The vegetable element of their food was composed of mulberries.

Of all the stomachs examined, only seven (all taken in the month of May) contained any mineral element, such as gravel, etc. In three of these this was composed, in part, at least, of the shell of some mollusk, which it might be supposed had been eaten for the sake of the lime for egg-shells, but one of the trio was a male.

The insects eaten have not been submitted for specific identification to an entomologist, but the orders were represented as follows: Dermaptera in one stomach; Orthoptera in four stomachs; Coleoptera in fourteen stomachs; Diptera in eight stomachs; Lepidoptera in thirteen stomachs; and Hymenoptera in ten stomachs; from which it appears that beetles and caterpillars were the favorites. Arachnids (spiders) also occurred in two stomachs.

The representatives of the first of these orders were three specimens of *Forficulæ*, or earwigs, rather rare insects of nocturnal habits, which are said to hide by day in flowers, where they were probably found by the birds. The Orthoptera were represented by the jaws and some other remains of grasshoppers. Several species of beetles represented the Coleoptera, two belonging to the family *Scarabæidæ* and two to the *Chrysomelidæ*, while some jaws were found that probably belonged to one of the *Cicindelidæ*. Among the *Chrysomelidæ* were found seven specimens of the well-known elm leaf beetle (*Galeruca xanthomelæna*).* The Diptera

[* The fact that the birds eat the elm leaf beetle (*Galeruca*) is abundantly attested by our own observations in the field. They have been seen in small flocks on elm trees on the grounds of the U. S. Department of Agriculture, greedily devouring these insects, and the same observation was made on elms at the Maryland Agricultural Experiment Station in 1891 and 1892. That a second species of the same family was eaten is of special interest, since it shows positively that the members of this family, though possessed of a disagreeable smell and taste, and mostly avoided by birds, are not distasteful to the cedar bird. The *Chrysomelidæ* include some of the most harmful leaf beetles known, among others the Colorado potato beetle, the striped squash and melon beetle, and the destructive leaf flea beetles.—W. B. B.]

are represented by the Tipulid flies, remains of which were found in several stomachs. The remains of the Lepidoptera consisted of many small caterpillars, of which not less than 100 individuals were found in one stomach, and many more in others. Several ants and a great number of very minute insects, perhaps ichneumon flies, represented the Hymenoptera. Five spiders were found in one stomach, and a trace of one in another.

The vegetable remains found in these stomachs consist entirely of the pulp, skin, and seeds of fruit, and some remains of flowers, with the possible exception of a single seed of some species of grass, which may have been taken accidentally. Of the eighteen birds taken in May, ten had eaten the stamens and petals of flowers. These were in some cases so mixed with the remains of very small insects as to suggest that one might have been eaten for the sake of the other, but which was the preferred element remains in doubt.

Of the birds that had eaten fruit, twenty-four, or 19 per cent of the whole number, had taken varieties that are or may be cultivated, viz, cultivated cherries by seven birds, mulberries by four, *Rubus* fruits by eleven, and apples by two. As these last were taken in the month of February, they can hardly be considered of any great importance from an economic point of view. With regard to the *Rubus* fruits and the mulberries, it is equally as probable that they were wild as cultivated, for the former, at least, are of universal distribution, and, during their season, usually can be obtained more easily from fields and roadsides than from gardens.

One bird was found to have eaten the berries of the common asparagus, which also may be noted as having no special economic interest.

Of the wild fruits eaten the following species were identified with certainty—

Juneberry (*Amelanchier canadensis*).
Hackberry (*Celtis occidentalis*).
Dogwood (*Cornus florida*).
Huckleberry (*Gaylussacia* sp. ?).
Red cedar (*Juniperus virginiana*).
Mistletoe (*Phoradendron flavescens*).
Pokeberry (*Phytolacca decandra*).
Black cherry (*Prunus serotina*).
Choke cherry (*Prunus virginiana*).
Choke berry (*Pyrus arbutifolia*).
Black elder (*Sambucus canadensis*).
Black haw (*Viburnum prunifolium*).
Frost grape (*Vitis cordifolia*).

In several stomachs remains of fruit were found without seeds or other characteristic parts, so that identification was impossible.

To sum up, it may be said that four facts seem to be reasonably well established, although it is possible, and perhaps probable, that a more extensive research may change or at least greatly modify them:

(1) That the cedar birds eat a certain amount of insect food at all times when it can be obtained, aggregating in the case of the stomachs examined 17 per cent of the food for the whole year; (2) that the greatest amount of insect food is eaten during the months when fruit is most abundant; (3) that the greatest number of insects is eaten during the month of May, with a decrease during the succeeding months until September, when the percentage again rises; (4) that the young while in the nest are fed to a very great extent upon insect food.